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SCIENCE AND FAITH.¹

II. INTRODUCTION TO MAN AS A MEMBER OF SOCIETY. (CONTINUED.)

III. ANIMAL SOCIETIES.

WE HAVE seen that the principal agent employed by evolution in the creation of organisms of increasing complexity is association. Individuals join together in aggregates, preserve their independence for a greater or less period of time, gradually adapt themselves to one another, and end by becoming amalgamated in a single organism. Where there were many individuals there is now but one. Cohesion has given rise to continuity among all the parts, that is to say, to morphological unity.

The kind of association which we are now about to consider is entirely different. Here, the individuals, although still parts of aggregates, are unrestrained and distinct ; they come and go ; their egos are preserved intact ; the bond which unites them is virtual not material. Nevertheless, a large body of philosophers regard the two sorts of association as essentially the same ; others, but slightly differing from them, restrict themselves to simple comparison. Some writers have gone so far as to contend that their principles and organisations, rudimentary in animals but as real there as in man, as well as the laws that govern them, are identical. We shall see what this amounts to.

We have already learned that morphology and physiology both tend to reduce the causes which lead animals generally, and the

¹Translated from Dr. Topinard's MS. by Thomas J. McCormack. For the two preceding articles of this series see Vol. VI., No. 1 and No. 4.

highest particularly, to form temporary or continued associations, to two : the necessity of satisfying the wants of the organism, the upshot of which is egoism, as a matter of imperative duty ; and the need of relations with one's fellows, which culminates in altruism, a product of development from egoism by differentiation.

Struggle for existence, emulation, and competition,—three things which hang together,—are the logical consequences of egoism. The best endowed, those which know best how to take advantage of the opportunities offered, survive and increase. The acutest form of this antagonism is where one animal, to stay his hunger, is forced to devour another. A second widely-spread form is *parasitism*, in which the animal takes up his abode upon or within another and partakes gradually of the latter, according to his needs. Next comes *commensalism*, in which the animal still selects its abode on the surface or in the interior of another, but confines its operations to taking advantage of its situation without doing harm to its host. Example, the little red crab of our common oyster. The following cases are of an allied order : the case of *Amphibena*, a bird which inhabits ant-hills under sufferance of their proprietors ; that of *Elaphis esculapis*, which shares its nook in the thicket with a swarm of hornets ; and that of the pilot.fish and the remora who keep company with the shark.

Next comes the state of *unilateral mutualism*, in which one species is made use of by another and performs services for the latter but without receiving anything in exchange. The instance of the crocodile and of the bird *Trochilus*, on the banks of the Nile, is well known. This bird performs two services for the crocodile. It enters its mouth and dispatches there the worms and leeches which trouble the crocodile ; it flies rapidly away, giving vent to a peculiar cry when the ichneumon, the enemy of the crocodile, approaches, thus apprising its companion of the ichneumon's presence. In return the crocodile shakes its tail whenever it wishes to close its mouth, thus giving the bird warning. The crocodile in no wise recompenses, but contents itself simply with respecting the person of the little animal. The service rendered is unilateral. But it is easy to understand that by the exercise of extremely little intelli-

gence, if not unconsciously, the crocodile may be led to defend its Trochilus. The same remarks are applicable to birds which associate with certain Ungulata—as Hyas and Ardea with the hippopotamus, Textor with the buffalo of Kaffraria, Buphaga with the elephant of Asia, Ardeola with the elephant of Africa—and which follow them and devour the insects lodged in their thick skins. Interest is the sole impulse of these birds, and in all likelihood it would also be that of the Ungulata in defending them.

The domestication of one species by another is a further instance of unilateral mutualism. A good example of this is that of certain ants who reduce other species to slavery and allow themselves to be fed by them. When man causes domesticated animals to administer to his wants, his pleasures, or his caprice, he supports them in return for their pains, but it is also true that he cruelly slays them when they have ceased to be useful or pleasing to him.

As an example of *bilateral mutualism* we shall cite the case of certain aphids and ants. The aphids secrete an abdominal fluid which distends them; the ants are passionately fond of this secretion, suck the same from the aphids, and finally, in order to keep this precious source of nutrition always at hand, provide them with food; the result being that the aphids are converted into genuine milch cows which are kept and watched in stables. Another example is that of the indicator-bird or honey-guide, and man. The former arrests the latter by his cries and points out to him the location of beehives, by which both then profit. If this partnership were not formed, the one could not obtain the chrysalids of which it is fond, nor the other the honey. Continuing thus, we come to the cases where one animal borrows the services of another temporarily, as is the case with the serpent, who is ferried across a river by a duck, or to the cases where several animals assist one another in crossing streams of water, in lifting a large stone, in moving the trunk of a tree, in constructing a dam, in hunting, or in mutual defense.

The second cause which induces animals to associate together is possibly more powerful—*the need of company*. The struggle for

existence is not so general nor merciless as some extreme disciples of Darwin would maintain. There are frequent lulls. Many species do not have antagonistic wants ; the animal is not always possessed of blind hunger ; he does not always covet the place of his neighbor ; his motives for quarrelling are sometimes extremely slight. The Carnivora are the born enemies of the species that constitute their food, but the Herbivora have only a desire for plants, fruits, roots, barks, etc. Both the one and the other have their moments of necessary repose. Rest is as imperious a want as activity. The Carnivora give most of their time to activity, but the Herbivora spend the greater part in rest. Buffon goes too far, but is in a measure right, when he says : "The animals that live on the fruits of the earth are the only ones that form societies. Abundance is the foundation of social instinct, of that gentleness of manner and peacefulness of life which characterise only those who have no grounds for quarrelling." In fact, a danger which keeps one constantly on the alert, a gloomy climate, a desert country, the necessity of always thinking of the prey which one stands in need of, lead to agitation, to defiance, and to egoism. On the other hand, security, the absence of anxiety, beauty of environment, abundance of food, and rumination, lead to *far niente*, to sympathy, and to love. The animal has no aversion for those who intend him no harm ; he approaches, regards his observers with curiosity, and even seems to solicit their caresses. Darwin has described the tameness of wild birds towards man. The latter is shunned only by animals who have learned at their cost to fear him. Man is the greatest enemy of animal societies. Prior to his time, they were unquestionably very numerous. The pastures of Pikermi in the Miocene epoch, the innumerable and multifarious herds of mixed species which the first travellers in Central Africa encountered, are a confirmation of this fact. The societies of buffaloes, of beavers, of chamois, and of numerous other mammals, all dwindled and melted away on his coming. Extensive societies of birds are encountered only in regions sparsely settled by man, as in the northern countries which Dr. Labonne visited. Where man does not slay, he domesticates. The natural troops of the

Andes and of the Himalayas have been replaced by more or less domesticated troops. We assist in the destruction of animal societies.

Whatever be the physiological mechanism by which it is engendered, whether that which I have set forth in a preceding article or some other, it is an undeniable fact that the social sentiment does exist in varying degrees in the majority of animals. All, from the reptiles up, but particularly the birds and the higher mammals, possess the emotional sensibility from which it is derived or which is the consequence of it. Animals associate individually with their fellows or with different species ; they exhibit sympathy, and they love, sometimes intensely, sometimes unto death. Every one has witnessed the surprising friendships which frequently spring up between two animals of contradictory characters, even among Carnivora,—friendships which sometimes neutralise the most antagonistic instincts. This sensibility is differentiated in a multitude of ways. Mr. Romanes has followed it up under the heading of "Emotions" in his work on *Animal Intelligence*. It is an admitted fact that in domestication man has only developed qualities which pre-existed in the species. No one will deny but altruism has attained its highest development in the dog, to mention but a single instance.

* * *

In the Fishes we meet with five or six kinds of associations or assemblages, to wit: (1) assemblages between species or between individuals of the same species which should be styled *indifferent*. These are numerous even throughout the entire range of invertebrates, as among the sponges, corals, mollusks, and insects, and depend on conditions of nutrition, of temperature, or shelter, of sandy or rocky bottoms, of calm or agitated environments, according as these conditions suit with the same needs of different species. All that is necessary is that such contiguous species should have little ground for quarrelling. (2) Assemblages of the same species, the object of which is hunting in company. Such are the shark and the dog-fish who form shoals in the Channel and pursue the herring ; or the carps, who also "live together," we are told, and hunt in company. (3) Associations of the same species for distant voy-

ages. The simple fact that we have to deal here with one species only, like the herring or the sardine, proves that such assemblages are less indifferent than the others. At certain times of the year bands of fishes assemble and travel off either for a change of climate by passing from a cold to a warm region, or in order to find certain kinds of food which abound elsewhere. These bands or shoals frequently comprise a countless number of individuals. Fishes enjoy exceptional facilities for such migrations; they are rapid and easy swimmers, and the currents, too, help them much. (4) Migratory associations, having in view the special end of spawning in remote but favorable localities, to which it is their custom to resort for this purpose. (5) Still another sort of this last kind of association, the object of which is less definite. The salmon is an example of it. Born near the sources of rivers, the salmon descends to the sea, sojourns there seven or eight months, and then again ascends in shoals of from thirty or forty to the place whence he came to perform there the functions of reproduction. Are the fish acquainted with one another under such circumstances? We do not know. At any rate, in certain species they play together.

In the Batrachia and Reptiles one of the conditions of assemblages is greatly weakened. These animals have not the same facility for moving about that fishes have; they creep around on the earth and are frequently very clumsy. Among the terrestrial Reptilia certain crocodiles undertake migrations, but only for short distances, along the banks of rivers. Among the marine Reptilia may be cited the turtles who journey annually to deposit their spawn on distant shores. Indifferent assemblages are frequent, for example, among lizards upon a surface exposed to the sun, or among crocodiles upon the shores of a lake or of a river. Does any durable bond actuate them? Crocodiles thus associating are totally indifferent to one another; no tie whatever results from their union. The lizards, on the other hand, live in perfect harmony and play together; some wander about in little bands, like the Varanus and the Gecko. The blind worm (*Anguis*), the rattlesnake, and *Tropidonotus viperinus* also associate in bands. Marine turtles remain together even after spawning, but seem to take no interest in

one another ; they neither engage in mutual attack nor make mutual defence, but swim along together from force of habit. Was it this sort of companionship which led to migration for spawning, or was the contrary the case ? A special cause of assemblages, entirely passive in character, may be observed in reptiles. I refer to their hibernation, or periodical torpor, during the long months of winter, where great advantage results from keeping each other warm in holes. Snakes and blind worms (*Anguidæ*) are thus frequently found twined together in solid masses. In 1876, in the forest of Fontainebleau, opposite Thomery, while blasting rock, the workmen came upon a cavity containing three hundred and twelve vipers who had taken up their abode there for the winter.

Birds.—These present all kinds of assemblages save that of hibernation, to-wit, indifferent assemblages ; assemblages by pure sociability ; assemblages for migratory purposes ; assemblages between different species ; assemblages for nesting together ; and family assemblages.

The kind which gives rise to the largest assemblages is migration. The birds are in this regard even more favorably situated than the fishes ; they cut the air with almost vertiginous velocity, changing their climate at will. Some in Europe, for example, descend from the northern countries, as is the case with the duck ; others, starting from central regions, fly to the shores of the Mediterranean and Africa. The life of a migratory bird is passed as follows : In the winter in the South it lives according to its habits, either alone, or in groups, or, in exceptional cases, in pairs, dating from the preceding season. In the spring it departs. Reaching its destination, it devotes several months to reproduction, and during the time which is left to it it resumes its usual habits. In autumn, or later, it takes its flight again to the South. Sometimes it departs alone and remains alone during the whole passage, as does the woodcock. Sometimes it departs alone but falls in with companions on its way, which is the case with the quail, who ultimately arrives in flocks of some size, part of which stop in Provence, but the majority of which reach Africa. In some cases the two sexes form distinct groups, which do not join each other until after their ar-

rival, the males being in one flock and the females and their young in another, as is the case with the turkey and the fighting sand-piper (*Philomachus*). Most frequently a signal is given, all the individuals of the same species within a certain region assemble, turn, soar upwards, and depart in a body. Of this kind are the passenger-pigeon (*Ectopistes*), the swallow, the stork, the crane, the crow, the goose and the rook. Some journey only by day, others by night. These flocks vary in number from a few individuals to hundreds, to thousands, and, in one instance of the passenger-pigeon, estimated by Audubon, to 1,100,000. Sometimes isolated individuals or whole flocks of other species join them. In the majority of these societies harmony reigns; in others quarrels and serious combats arise. Save in the turkey, there is no noticeable head or chief of the flock, but frequently, as is the case with the crane and wild duck, there are leaders who take the head of the column and relieve each other by turns. Their flight is confused, in the shape of a triangle, whose vertex cuts the air, or in columns, or in groups. Sometimes the aged males, or the females with their young, or even the young males will fly separately. The few couples which are observed are those which had not separated on departure, or who, on returning, had just begun to mate for the coming season. On their arrival the assemblage or flock may remain intact for some weeks, or for one or two months, but in most cases it breaks up and is dispersed. In sum, they all obey collective habits which have been insensibly formed, consolidated, and converted into a periodical instinct, which the bird obeys. A quail, for example, kept in a warm cage, well fed, and ignorant of everything about him, experiences lively agitation at the time of annual migration, seeks to escape, dashes himself against the bars of his cage, and, as the upshot of his desperate attempts, may drop down dead. It would be useless to add that sedentary societies are transformed most readily of all into migratory societies, and that the spirit of sociability which is habitual with them has also its effects upon the latter.

Sedentary assemblages present many gradations from the indifferent or interested form to that which I have styled assemblages by pure sociability. It is not a temporary and intermittent neces-

sity that is in action here, but commonly a quite pronounced need of playing together, of singing together, of making responses, of abandoning oneself to all manner of pranks and crochets—in other words, of thorough enjoyment through companionship. They are permanent, but during intervals either of rut or of the whole series of reproductive phases. They are made up, according to the season and the species, now entirely of males who have completely or partially abandoned their females, now of males and females followed by their young, who have grown up and are continuing their education under the supervision of both parents or of the mother alone, and again of males, of females, and of offspring who are totally emancipated, the former either paying no regard whatever to each other or still continuing united.

Contrasted with the sociable birds of the preceding category, are the unsociable birds. The following are a few types leading from the latter to the former.

The first type is that of birds who are perfectly egotistical, who live entirely alone or indifferently with others without bestowing on them the least concern or paying them the least attention. Examples are the woodcock, the pheasant, the thrush (*Turdus*), the king-fisher, the cuckoo, and the albatross. The second type is of birds who in general life are egotistical, but possess some traces of family sentiment, and occasionally associate with a few of their fellows for purposes of hunting. The eagle, the vulture, and the falcon are varieties of this type. The third type is of birds who assemble in vast numbers without manifesting any interest at all for one another, but who understand on occasions how to combine their movements for common defence. Examples of this type are several marine birds like the sea-swallows and many stilt-birds. The fourth type is composed of birds which are egotistical, but which form closed and exclusive societies into which no strangers are admitted. An example of this type is the swan, who prefers to live alone rather than to join other groups even when it could be admitted. The fifth type is of birds who form open associations where harmony and happiness reign supreme. These are the immense majority. Such are the passenger-birds, the swallows, the Corvidæ, a large number

of stilt-birds and palmipeds, and the creepers. The parrot is the most advanced representative of this type. Parrots make expeditions like those of the cercopithecoid monkeys, which we shall speak of later, form organisations and station sentinels.

One of the most striking proofs of the spirit of sociability among birds is found in the facility with which many of them associate with individuals of different species but slightly distant from them zoologically. Here again a gradation appears, running from absolutely indifferent assemblages to the most complicated and harmonious societies. The following are the degrees : (1) unsociable species which chance temporarily holds together but who take no interest in one another ; examples of which are the eagle, the buzzard, the vulture, and the kite. (2) Species whose mutual company is agreeable but who do not seek one another, who contract no unions with one another, and derive no advantage from their mutual society ; examples of these are the nut-hatch (*Sitta*), the titmouse (*Parus*), the finch (*Fringilla*), the kinglet (*Regulus*), and the creeper (*Certhia*). (3) Species which are egoistic and solitary by nature but which possess qualities that lead other species to gather around them in order to take advantage thereof, and who neither avoid these species nor take any notice of them. Examples are the greenshank and the curlew, who by a peculiar warning cry give the danger-signal to all the inhabitants of a locality. (4) Species which associate together pleasantly, the one having qualities by which the other profits. Examples, the godwit (*Limosa*), a genus of stilt-birds (*Hypsibates*), and the avocet ; the first, which is more intelligent and more vigilant, ultimately acquires through these unions a considerable authority over the others. Another example are the unions in the marshes of Hungary between the heron, the ibis, the cormorant, the tern, the goose, and the pelican. (5) Sociable species in all their relations with their own fellows and with stranger species, without there appearing to be any interest on either side, the motive being absolutely the instinct of sociability. These are almost the same as those of the preceding fifth type : the passenger birds, the parrots, the Corvidæ, etc.

The last form of assemblages is for nesting in common. Fe-

males abandoned by their males immediately after rut sometimes *lay* their eggs all in one nest, not with a view of sharing the common burden but for the better defence of their eggs. The turkey is an example of this type, the male being the sworn enemy of its eggs. The polygamous females of the ostrich do the same, but for a different purpose. We can recall no example of females abandoned by their males actually *nesting* in common. On the other hand this practice is frequent in the second and third periods when the father participates in it. Examples are the gannet, the cormorant, the petrel, the swift, the chimney-swallow, the rook, the heron, the weaver-bird, the bee-eater, etc. At times a single species, and again different species, associate thus together.

Let us stop and consider a few cases. The gannets, one of those species which in other latitudes help to produce guano, have been described among others by Audubon as they live at the mouth of the St. Lawrence. They arrive from the South in successive flocks of from fifteen to one hundred and take up their abode on the islands there. Here they copulate and construct their nests, two feet apart in parallel rows. If one of the females steals the twigs of its neighbors, the others will all combine against her. When they brood the males hunt for them in the surrounding regions and on occasions will even sit themselves. Later, when the young are able to run about, or fraternise with one another, the nests are trampled upon and the lines effaced. At the end of four months about, all is finished, the young quit the rocks, emigrate, and do not return until the following year. Audubon also describes the nesting places of chimney-swallows, which are the same as tree-swallows, at least prior to the transformation of their instincts. These, too, are migratory birds, and form in their nesting places veritable societies. Audubon has counted fifty nests in the cavity of a sycamore tree and has seen as many as eleven thousand swallows repair nightly to this place in search of shelter. He saw as many as one thousand enter a chimney one evening.

The communal nesting-places of the heron (*Ardea*) of our country are extraordinary from another point of view. A more or less extended group of trees is chosen by them in a swampy country.

Thousands of couples repair thither, each tree supporting from fifteen to one hundred nests, together and at different heights with the nests of other species such as *Nycticorax*, *Ardetta*, *Phalocrocorax*, and *Herodias*. Nothing is more deafening than the hubbub which these various united species make. The most curious case is that of the weaver-bird (*Ploceus*) and particularly that of *Philetærus*. Levaillant, the South-African traveller, has counted as many as three hundred and twenty nests or couples on the same tree, and in this instance all of the same species. The nests touch and are covered by a sort of umbrella-like tent fastened in the branches. In these cases the subsequent life of the bird is not prejudiced. The *Philetærus* when its family is broken up returns to its old life with other and different species. In its social intercourse with these no trace survives of the families which temporarily existed in the previous state.

This leads us to close our remarks on birds by insisting on the facts relative to the varied influence which the family instinct exercises on the social instinct. It is certain that in a general way the species which are most sociable are also the most highly endowed with family qualities. And as examples we might cite the passenger birds, the *Corvidæ*, and the creepers. But a large number of species with a family turn are quite refractory to any kind of social alliances, as is the case with the *Raptoreos*. On the other hand the *Gallinaceæ*, who are considerably averse to family unions are strongly inclined to sociability whether with their fellow-birds or with other species. I need only recall the case of the wild duck who abandons his females and does not return until the young have grown up, but is yet extremely sociable. Of particular cases I may mention the water-hen, who has a strong family turn but forms neither sedentary nor migratory societies, and particularly the *Molothrus*, which lives a social life but has so little of the family sentiment as to be given to polygamy and polyandry, which, further, does not form couples, and whose female lays its eggs in the nests of others.

In another point of view, while the sexual instinct forcibly brings the sexes together, and the family instinct brings them to-

gether as a matter of option, on the other hand the sexes are frequently observed to separate in general life and to form distinct groups within the flock or apart therefrom. The young males themselves separate from the young females, who stay a much longer time with their mother. Thus in the pheasant, the young males quit their mother in the autumn, whereas the young females do not leave her until the spring. As to the natural duration of the family, which is fixed by the ability of the young to take care of themselves, we have already seen that it is sometimes abbreviated by the return of the sexual desire in the parents, who drive away their young *nolens volens*. Nevertheless, when there is but one brood a year, or where only the young of the last brood are concerned, there is a distinct tendency on the part of the young to remain longer in the society of their mother, who is then not opposed to their staying, or may be even desirous of it. Such is the origin of the coveys of partridges which pass with us the winter and do not break up until springtime, when rut returns. Coveys of this kind even join others and form multifamiliar societies. In the American ostrich (*Rhea*) this occurs ; but the society has here little coherency ; the members wander off or pass from one flock to another. In the great bustard several families join and form flocks amounting to several hundred individuals ; but in the spring during the period of rut the society breaks up. The only case among birds favorable to the theory that the family is the nucleus of society, is that of the guinea fowl. It has from fifteen to twenty young for which both parents care. At the end of the season six or eight families are joined together, harmony reigns in the bosom of this little society, an old male governs it ; and yet they do not know how to render each other mutual assistance in times of danger, but all flee in different directions. We shall conclude on this subject later.

Mammals.—These enlist our whole attention. They present all the forms of assemblages, of a more or less social character, which we have as yet encountered: indifferent, accidental, and temporary, for purposes of migration, for purposes of reproduction, sedentary, between different species, and for purposes of hibernation. Marine mammals, who have the same facilities for speedy

locomotion as fishes, bats which fly like birds, and certain Rodentia and Ungulata, offer examples of association for distant voyages. In the same order of facts, we may recall the short journeys which the marmots and chamois undertake in the winter from regions of snow to the valleys. The seals and the Chiroptera afford examples of distant journeys for reproductive purposes. We shall next say a word regarding assemblages for purposes of hibernation.

We have spoken of snakes and slow-worms (*Anguidæ*) who enter a state of torpidity during the winter, and who are found entwined in large masses in cavities and holes. Birds fly from the cold with too much facility to have any need of hibernation, and besides they are warm-blooded. In the lower mammals hibernation is pretty common, but only in individuals of solitary habits like the hedgehog, the shrew (*Sorex*), the dormouse (*Myoxus*), the hamster (*Cricetus*), and the harvest-mouse. Hibernation is common is rare, but occurs, for example, in the mole, who has a disposition to burrow in common, in the squirrel where the whole family burrow by the side of one another, but it is notably the case with the marmot. In the higher mammals a trace of hibernation, relating not to society but to family life, is observed in the white polar bear during the period of gestation. The female of the white polar bear digs a hole and, getting into it, causes herself to be covered by snow, staying so covered until spring. In short, hibernation points to nothing as regards the disposition of mammals to form societies.

In the lower mammals, such as the Monotremata, the Edentata, and the Insectivora, social troops are not formed at all. The majority, if not all, live solitary lives, and some are entirely wanting in the family spirit, as is the case with the porcupine ant-eater, the Armadillo, the ant-bear, the pangolin, the sloth, the tanrec, and the shrew, while others are less refractory in this respect, like the duckbill and the hedgehog. The aardvark (*Orycteropus*) is the only one of the Edentata that is met in twos or threes. The mole is the only one of the Insectivora who possesses any social instinct; each has its special burrow, but common corridors exist in which as many as fifteen to twenty individuals dwell.

In the Marsupials the progress is scarcely perceptible. The

majority live alone. Still, in the kangaroo-rat several congregate in a common burrow. In the common kangaroo we meet with indifferent assemblages ; these animals graze together in bands numbering as high as eighty individuals, the same ones returning on the morrow either as before or with others as chance decides. Sometimes three or four evince a preference for one another, but no mutual interest. On the slightest occasion each one flees in his own direction without any attempt to join the troop again. And yet the kangaroo exhibits some susceptibility to education in the hands of man. All have heard of the kangaroo boxers.

In the Rodentia the progress is apparent. Some live solitary lives like the dormouse, the hamster, the porcupine, the jerboa, the hare, and the squirrel. The jumping-hare, it is said, lives in large families comprising several couples. In the South American rodent *Lagostomus*, a dozen families occupy the same burrow, over which a male watches and gives the signal in case of danger. The vole or meadow-mouse is very sociable and sometimes lives in large colonies, the burrows of which communicate with one another and are dug side by side in the same field. The voles, and particularly the lemmings, are celebrated furthermore in northern countries for their enormous emigrations. Their excessive fecundity enables them rapidly to exhaust a country, whereupon they set out in quest of new feeding grounds, in obedience to habits which have persisted for ages and frequently survived their reason for being. Mice and rats, as we know, gather in considerable numbers in localities favorable to their wants. Rats sometimes sleep in a sort of common nest, embracing to keep warm. At night they travel in troops, either in quest of new localities, or to make excursions in the open, all the while observing strict rules of prudence. Rabbits are divided into tribes occupying separate fields ; each couple has its own burrow, connected with the others. They go out together in the morning and at night are watched over by an old male who apprises them of danger and urges on the stragglers. The marmots live together and have two kinds of dwellings,—one in summer on elevations, the other in winter in lower places, where they hibernate in common from seven to nine months. The prairie-dogs have

what the Indians call villages. Each has its burrow with well-kept winding pathways between ; the lookouts show here and there their heads ; they pay one another visits and play together ; the habitation of some important personage being the main point about which their wanderings centre. If one of them is wounded or killed, another will quickly drag its body into the nearest burrow while the hunter is reloading his piece. Other and not less celebrated villages were those of the musk-rat and the beaver. The huts of the latter are grouped about a pond ; all the members of the community join in cutting and hauling trees, in the constructing or repairing of dams, in digging canals, and in storing provisions. Their works are maintained from generation to generation, and from time to time the excess of the population move off and settle farther away.

The question may be asked with regard to the beaver, whether mutual assistance is the original motive of their living in societies, or whether this mutual assistance is a secondary outgrowth. In the prairie dog everything points to the conclusion that the desire for company is the sole motive. In the multitudinous swarms of lemmings necessity and imitation may account for everything.

The Chiroptera are allies of the Insectivora. They all live in bands which hibernate together and sometimes migrate from one distant isle to another. In France there are famous caves which bats have inhabited from time immemorial and where they have accordingly deposited a thick layer of guano. The interesting point in the history of Chiroptera is this : The females, having been abandoned by the males after rut, gather together in groups of a dozen each in some hole of the cave, where they give birth to their young and rear them in common.

The marine mammals present a similar case, which recalls the practice of communal nesting in birds, and which is complete, complex, and prolonged. We shall speak of them now, although in some respects they are allied to the Ungulata.

The marine mammals are all polygamus, with the exception of the walrus and the dugong, which are monogamous. They all live in herds. The whale is less social, often living a solitary life, yet

sometimes forming herds for the purpose of voyaging or of rut. Some assemblages, the main object of which is play and companionship, are also met with, as among the dolphins. There are also sedentary societies. Thus M. Trouessart speaks of a colony of seals who had taken up their abode in the Bay of the Somme. The five hundred sea-lions at the Golden Gate, near San Francisco, which are protected and fed, form also a sedentary colony. But the interesting groups, although difficult of explanation, are those which have the triple object of voyaging, companionship, and reproduction. Let us essay a sketch of them. These assemblages are composed, according to the season, of complete polygamous families, with a male swimming at their head, of groups of so-called solitary males, of groups of pregnant females, of groups of variously aged young, and of scattered bachelor males. Under what circumstances do these elements separate or come together? Let us abridge the description given of one of these species, the *Arctocephalus* or sea-bear of the Falkland Islands, by Steller and others.

In November, we are told, the old males arrive at these islands and scatter out on the beach in long files. In December the females arrive, and immediately violent combats are fought for their possession. The young males arrive several months later. At the end of April they all put to sea; in the middle of June the beach is deserted. So far, as I should judge, their conduct has reference solely to rut. The female has one to two young and carries them from eight to ten months, which brings us to the following season. The following, then, is the picture which is drawn for us. Each male has from three to fifteen, thirty, and even as many as forty females, and his entire family may amount to as many as one hundred and twenty individuals, which includes, surely, the young of one year. The beach is divided off into sections ten metres square, each occupied by a different family. The females pass their time in sleeping; the young play together like little dogs; the male is near at hand, and looks on; if the young ones come to blows he comes growling upon the scene, separates them, embraces them, and continues with them their game. If the females behave badly he chastises them; they crawl at his feet, seem to beg his pardon,

and shed copious tears. At times males and females weep together. At a period which is not mentioned the old males separate and go away. A little later all of them quit the beach, each family swimming together. What happens afterwards? Do these families and the various other straggling groups unite and form assemblages comparable to herds or societies?

Among the mammals the Carnivora are the counterpart of the Raptorees among birds. They live on flesh, spread terror about them, are ferocious, and reap none but the fruits of egoism. In hard times they devour one another, and, when forced, to it, even eat their females and their young. Nevertheless, some associations are formed among them having in view useful ends. At the head stand the Felidæ. These live alone or in couples, chance alone occasionally inducing some of them to unite for the purposes of chase. The leopard is met in troops of from six to eight. The Canidæ vary. The Colsun of Deccan hunts in packs of from fifty to sixty individuals, the dingo in families. The wild dogs of Constantinople and of Egypt are divided into tribes, each having its headquarters and admitting no stranger. The jackal sometimes hunts alone, sometimes in company. Wolves lead solitary lives in summer and combine in winter into large packs. The blue fox of the poles lives in packs, stations sentinels, but are not less unsympathetic for this reason; they quarrel incessantly and engage in bloody combats. The Viverridæ live solitary lives. A species of the mongoose (*Hippes*) and the daman (*Hyrax*), of Abyssinia, are often found together, and give an instance of association between different species. The Mustelidæ also live solitary lives; of these the badger is the most egoistic specimen. There is one exception, however, the weasel, which has a developed social instinct. Two or three stories have been told about it in this connexion. A man once carelessly attacked a weasel, who, driven to bay, uttered a war-cry to which twenty weasels responded; these, issuing forth in all directions from their burrows, charged the hunter and forced him to flee covered with wounds. This is solidarity. The Ursidæ live partly solitary lives and partly in small troops. The coatis (*Nasua*) in this respect are of two kinds. One lives a solitary life when not in rut, and the

other lives in troops of from fifteen to twenty individuals, conducted by the oldest. But the harmony in these groups is far from perfect. The otters (*Lutra*), finally, live solitary lives, although in one marine species family life is, as we have already remarked, considerably developed.

The Ungulata are quite differently situated from the Carnivora. They are herbiverous, their food is obtained with a minimal effort and without strife. They pass a part of their time in ruminating with that serenity which every one has noticed. Their life has all the quietness and peace which Buffon regarded as the fundamental condition for developing the social spirit. They all live in small or in large herds, at times temporary but generally permanent, with regard to which the sole problem for us is to discriminate between what is accessory to the family and what is social. Some of them emigrate and their societies are then combined in greater or lesser numbers. Among the latter we will cite the reindeer who annually migrates from regions near the pole and returns there to obtain his favorite lichen in herds which have been known to reach one hundred thousand heads; the antelopes of Central Africa who go in quest of fresh pastures in herds numbering as many as fifty thousand heads; the buffalo who was formerly seen in incalculable numbers. A pioneer's wagon once took eight days to cross an unbroken column of buffaloes.

In the Solidungula all three kinds of herds occur: family, social, and migratory. The first is simply the permanent polygamous family, such as we have described among the wild ass (*Asinus hemionus*) and the onager, and which, as we have seen, was created as much by the desire of the male to have about him a herd as by the sexual impulse. The second is a union of a larger or smaller number of such families; the number of individuals here amounts to hundreds in the so-called turpans or wild horses of Mongolia, and to thousands among the cimarrones of La Plata. In the latter there is no observable leader. In the turpans there is also none; the command is collective and is lodged in the heads of the families. When the herd is attacked, they all form in a circle with the mares and the foals in the centre; their style of defence is methodical. The herd

is not a closed one ; if a domesticated horse takes refuge with them he is cordially received. Nevertheless, stallions without females and young males likely to give umbrage to the old males are required to follow on one side. The third kind of herd is formed for purposes of migration, and may be either the one or the other of the two preceding kinds, but particularly the second, created or augmented as the circumstances demand. A fourth kind is also met with among some Solidungula and resembles that which we have so frequently encountered between different species of birds. The zebra is an example of this class. It comprises two species, the daww and the quagga, of which rival herds, numbering from ten to one hundred individuals, do not mingle. One of these, the quagga, receives into its herds other species, such as the gazelle, the antelope, the gnu, and the ostrich. Is it need of company or utility which gives rise to these associations ? As in the birds the most vigilant of this species act as guides, particularly the ostrich who is highly esteemed for his prudence and sharpness of sight.

The ruminants have the same kinds of associations. In the guanacos and vicugnas of the Cordilleras the herd resembles that of the wild ass. It is polygamous during the three periods of rut, gestation, and family life. The male is a chief of a herd, is jealous of the young males as they approach puberty, and is followed by his females and their young with devotion if not servility. In the mouflon two species behave differently. In the *Tragelaphus* of Africa all live solitary lives ; when capable of reproduction the males approach the females in the season of rut, form with them a temporary polygamous herd and then abandon them, each resuming his old habits and the females being left alone with their young. In the musimon of Europe, permanent herds exist in which all ages and sexes are mingled. In the season of rut, the males form polygamous herds, with which they retire aside, whilst the remaining young males and females and the males without females select the oldest among them as their leader. When the season of rut is over, all rejoin the herd and pick out a general leader, the strongest and most esteemed among them. The females are merged in the general body, each having sole charge of her offspring. The males

evince no solicitude for the young, but assume their share of the collective responsibility and interfere in a body in times of danger.

Among the Cervidæ the monogamous reindeer is a type apart. There is a general herd in which all ages and sexes are mingled. Rut arrives ; couples are formed which go aside on the approach of parturition, afterwards wander around with their little one until the latter has waxed strong, and then rejoin the troop where the family appears to be prolonged. There is a period, thus, at which the herd is represented solely by the young of both sexes. Outside, a few solitary individuals are found, old males which have been driven from the herd. There are several leaders who relieve each other ; for example, in the nightly watch. In the stag (*Cervus*) the old solitary males are found isolated ; the adult males are most frequently found forming a little herd apart ; and the females with the fawns and the brockets are found united. In the season of rut the males capable of reproduction and the females come together and form a temporary herd whilst the celibates and other abandoned individuals gather in a second distinct herd over which they appoint a temporary chief. After rut, the solitary individuals return to their old ways of life ; the most sociable of the males remain with their females for a longer or shorter period of time. In Capreolus this union is intimate and protracted. In the Capridæ the whole breaks up into polygamy at the period of rut. The herd is formed by the females and their young of all ages. As is the general rule, the grouty and ill-natured aged solitaries are expelled from the herd. In the Bovidæ the herd is formed upon the model of the European musimon. The male performs the sexual functions, deserts the female who joins her companions, and then assumes the post of chief of the herd in partnership with the other males, one of them being selected to discharge the principal rôle.

In the antelopes differences are observed. There is the herd of the gazelles numbering from forty to fifty individuals and formed of monogamous families ; there is the polygamous troop of the capricorns (*Cervicapra*) in which the old females are utilised as sentinels ; there is the temporary troop, during times of rut, of the chamois, and the migratory troops, numbering from ten to fifty

thousand heads, of the springbok. We even meet here with associations among different species.

The Pachyderms are the oldest of the Ungulata. Several are on the eve of disappearing, not only by the hand of man but by the law of evolution which requires that species which no longer conform to present conditions of life shall disappear. There is reason for believing that certain of these species formed anciently numerous societies of which we now possess barely the remnants. They all live in troops of from three to more in the tapir, of from four to twenty in the wild boar (*Sus scrofa*) and *Phacochoerus*, of from four to ten in the rhinoceros, of from three to four or from fifty to sixty in the hippopotamus, and from four or five to fifty and anciently to two hundred in the elephant. The three individuals to which reference was made in the tapirs appear to bear to one another no family relationship, but are rather an indifferent assemblage, such as we meet with in the kangaroo. In the hippopotamus the groups of three or four may constitute families, but the groups of fifty or sixty are certainly assemblages of families. Among the Suidæ, the twenty individuals which I once counted in the hog (*Sus*) correspond without doubt to a maternal family with the young of several farrows and not to a polygamous family, for the male is not at all sociable nor even disposed to make himself the chief of a herd. Assemblages of several polygamous families are met with among the peccaries of South America, concerning which we read : "they come in numerous herds, the male marching at the head and the females following, with the young in the rear."

The elephant may be seen in herds ranging from five to ten, to fifty, to one hundred and fifty, and formerly in one case, to two hundred. Each herd is a family into which no stranger is admitted. The unfortunate individual who has lost his herd or who has escaped from domestication is taken up by none of them. He is obliged to lead a solitary life. They allow him to approach and drink at the same spring, but they never permit him to mingle in the herd at large ; thus he becomes ill-natured. The most prudent and most vigilant is chosen as the chief. Generally it is a male but sometimes it is a female ; the chief is deposed when his capacities wane.

He has extensive authority and is always obeyed. He has been seen to station as many as five outposts around the herd to whom he gives his orders and whom he changes. Harmony reigns in this society. The cardinal point is that this herd is really a family, I might add, a large family composed of relatives of all degrees. My reasons for so believing is Tennent's statement that each of these herds can be recognised by special physical characters which are common to all. This is a certain proof of consanguinity.

These lines were already written when my friend M. Louis Rousselet, the author of *L'Inde des Rajahs*, informed me that the males were often found separately in small bands. This would indicate a resemblance to many ruminants like the deer and the big-horn. The males always show a tendency to assemble apart, as do the females with the young. This last division would be the repository so to speak, the centre of the community, its constant fraction.

The Monkeys, from whom we still exclude the anthropoids, offer us numerous examples of the fusion of family and social elements, as well as instances of polygamous troops in which the male is master, and also some cases of solitary monogamous life. Several of them undertake journeys, but they do not form special migratory bands.

The Lemurs may be seen according to circumstances in couples, in small families, or in troops. Thus the Maki by day sleeps rolled up in couples, and by night roams about in troops of thirty or more.

The Monkeys of the New World present all forms. The Nyctipithecus, as we have said, is monogamous, but does not form bands. The Mycetes lives in polygamous families of from three to ten members and has been seen in groups of forty, which points to the association of several families. The Ateles lives in small bands in which besides the young and the females are several males. The Cebus lives in large troops comprising both sexes which other kinds of monkeys sometimes voluntarily join. The Saki, the Callithrix, and the Arctopithecus also live in troops of varying magnitude, some forming but one family and others composed of several. In

both cases there is a chief who in the one is the father and in the other the male in highest esteem. The line of demarcation between the isolated polygamous family and the society is difficult to assign with the defective data now at our command.

As to the monkeys of the Old World no doubt prevails. All live in troops formed of banded families. Examples are the Semnopithecus, the Macacus, the Cercopithecus, and the Cynocephalus. The expeditions of Cercopithecus are well known. The strongest male is the chieftain and directs the movements of the troop, stations sentinels, is the first to advance, climbs trees to reconnoitre, accelerates the movements of the tardy, restrains the precipitate, exacts silence, and by divers grunts and growls issues orders which are both understood and obeyed. They all help one another, cleanse one another, and mutually extract thorns and slivers.

The Cynocephalus is more remarkable still. Brehm, who gained his experience of them in Abyssinia, describes their life in considerable detail. Their troops vary from fifteen to one hundred and fifty individuals, quartered in districts of from a mile to a mile and a half wide not far from a spring. We find together, for example, from twelve to fifteen old males and from twenty to thirty females, the rest being the young of different ages. In the morning, or if it rains, they may be seen in the highest galleries and cavities of the rocks massed together in a body, with the young supporting themselves by preference on their mothers, and the older ones on their fathers. Later, or if the morning is clear, they go in search of their breakfast, lifting the stones, tearing up roots, and gathering fruits. After breakfast they climb up again to the rocks, the males take their seats upon the flat slabs and silently contemplate the landscape while the females watch their infants play and quarrel. Towards evening they repair to the spring, seek their evening meal and then pass the night in an old or in some newly found lodging-place. Brehm describes their offensive and defensive tactics under the direction of a commander-in-chief, their habit of prolonged observation before making a decision, the daring of some of them in their bold dashes to extricate a comrade from danger, and their overawing by attitude and look the dogs of their pursuers

who flee forthwith and take refuge behind their masters. He speaks of their collecting stones at a given point to throw at their enemies, of their even carrying these missiles up trees, and of their aiding one another in rolling the largest of these. Harmony reigns in the bosom of these societies, but between different species as the Gelada and Hamadryas old scores are sometimes settled in free and open-handed combat. M. Mizon has encountered in the neighborhood of the Benue, bands of Cynocephali numbering as many as one thousand who would allow no other monkeys such as the Cerco-pithecus and Colobus in their domains. The most remarkable instances of co-operation which I know of in the Cynocephali is that which Romanes has reproduced—of a regular combat delivered at the Cape against English soldiers. There was a perfect hail of stones. An old grey-headed male directed the operations of the various squads according to the strategic needs. The English were forced to retreat.

In the Anthropoids our knowledge is far from what we should wish. Like the hippopotamus, rhinoceros, and so many other animals, they are gradually becoming extinct, and their present state gives us no indication of what they anciently were. If they live at this day little in social groups, it is likely because they are not numerous. The following is a summary of our knowledge of them. The gibbon and the chimpanzee love to play and frequently unite and render actual concerts by striking with clubs the branches of hollow trees. The gibbon has been seen in troops of from one hundred to one hundred and fifty. The orang-outang has little social instinct; he lives a solitary life when old, or as a member of a family. Wallace has seen a male or female accompanied with semi-adult young, or three or four infants together, but never two males together. The gorilla has been met by Duchaillu twice in bands of from eight to ten individuals. As to the chimpanzee there is the statement of Schweinfurth based on the accounts of natives that the young associate in small troops. But particularly valuable is the exact affirmation of Livingstone which we have already quoted, that one of these species, the Soko, lives in troops composed of monogamous families.

Conclusions.—The mammals, in the matter of society, do not offer the picture which as the successors of the birds we should naturally have expected. The sentiment which engenders the paternal-maternal and monogamous family in the birds is weakened and has been diverted in the mammals, where in most cases it gives rise to the paternal and polygamous family. Also the social sentiment, which most commonly engenders societies in birds, has been weakened and diverted in the majority of the mammals. As a rule the bird is more altruistic, the mammal more egoistic. In the birds the two sentiments of family and society are quite irregularly distributed in the different orders; in the mammals they form a scale running from zero in the lower orders to a high point in the monkeys. The natural linkage of the orders will perhaps explain these differences: they radiate in the birds, they proceed by steps in the mammals.

The lower mammals, such as the Monotremata, the Edentata, and the Insectivora, are hardly better endowed with regard to family than the reptiles. In the Marsupalia, the Carnivora lead a solitary life while the few herbivorous species that graze together are still in the indifferent period. The Chiroptera form a special group. They seem to crowd into caves, not from any social instinct but because they find there conditions suiting their individual tastes. In the Carnivora, though high up in the scale and in intelligence, there are no societies, properly speaking, but simply temporary assemblages, having as their object attack in common, in which ferocity takes the place of cordiality. In some Rodentia two forms of association are highly developed,—the one for migrations on a large scale, and the other sedentary for mutual help and companionship. In the marine mammals association is developed with the twofold end in view of migration and reproduction, in the latter case in the form of polygamous families. In the Ungulata association is generalised under the triple form of isolated polygamous families, of banded polygamous families, or of associated monogamous families, the first being under the direction of a chief who is necessarily the common father, the two others under the conduct of a single chief chosen from among the fittest, or under that of all

the old males, acting as a single person. In the monkeys the associated polygamous form is general but mingled with less spirit of domination and with more altruism in the male.

Among the birds we have noted (1) associations among different species both for companionship and for mutual service, as frequent here as they are rare among the mammals; (2) large temporary associations for migrations, general as a rule, but rare among the mammals; (3) sedentary and permanent associations, of a cordial, gentle, and ingenuous character, quite different from those ordinarily presented by the mammals. A few orders here and there may be made the subject of parallels. The Raptore among the birds and the Carnivora among the mammals are quite analogous. Egoism, monogamy, family spirit, and no social instinct are their common traits. The owl and the weasel are exceptions; both are sociable. The parrots and the monkeys likewise are counterparts. Clamorous, easily teased, high family spirit and sociability, concerted expeditions,—such are their characters. In certain societies of birds, as the rooks, the swallows, and the crows, there are indications of the formation of a species of tribunals for judging and punishing crimes and misdemeanors committed either within the flock or by strangers. In some mammals and notably in the monkeys, sentinels are said to have been punished for neglect of duty in permitting the troop to be surprised. It is certain that some mammals, like the domestic dog, the cat, and the elephant, have a confused but trustworthy notion of good and bad, of what is permitted and what is forbidden, and of what is just and what is unjust.

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Let us summarise now some of our general conclusions.

1. All assemblages of animals, whatever may be the social form in which they have culminated, began as indifferent assemblages. Vague habits were unconsciously established between a few individuals; these habits were extended to others and even between different species. Pleasure resulted. The habits were confirmed, the pleasure grew. The social spirit was the result, it increased and led to organisations of life in common, often in the

roughest and crudest form, but furnishing the framework within which were developed the customs and characters leading up to those which may be observed in the society of man.

2. At their origin these assemblages, whether they were temporary or prolonged, had no object. Each obeyed his own caprice, the impulses and wants of the moment. Some individuals endowed with the spirit of observation, vigilance, and initiative ventured upon some act which the others imitated. Imitation is a powerful factor in all social and individual phenomena ; one must be a physician to appreciate its full potency. M. Tarde has assigned to it an exceptional rôle in the life of man ; M. Lebon has described its irresistibleness in the case of crowds. It intervenes incessantly and with more efficacy in animals where routine takes the place of reason. I shall always remember on the eve of the siege of Paris in 1870, the concourse of cattle which were gathered in the Bois de Boulogne. They wandered about dumbfounded. If one should start by any chance in one direction, a second, a third, then ten, a hundred, a thousand would blindly follow. The first pushed on by those behind seemed to be the chief, leading, although unconsciously, the entire troop. Hornaday has given a like description of the buffalo on the prairies. In this manner may be comprehended those astonishing migrations of immense bands of fishes, birds, and of some mammals. Chance crowned by success actuated the first, imitation drew after him the others. The habit once acquired the band was formed over again each year. There are migrations which have persisted for ages, although their original motive has ceased to exist. The instincts acquired are modified, transformed, and adapted to new conditions but with difficulty.

3. The causes of the formations of animal societies are numerous. The first is habit following upon indifference. The second is imitation. What shall we put third ? We were prepared, we must avow, after our biological review of the conditions of the problem, to find always in the front rank of the facts, individual interest, egoism, that "categorical imperative" which forces the ego to comply forthwith with the physical exigencies of the organism which it represents. It is not so, and why ? Because it is not logic that

determines most of the acts of an animal, but spontaneity. Without doubt, the first impulse of the animal touches his conservation ; he flees by reflex action when a danger is presented ; he throws himself upon his prey when he is hungry ; he gives tooth for tooth when attacked. He avoids the traps which are set for him. But when that first impulse is past, under ordinary conditions, the other natural tendencies quickly regain the upper hand. He gives way to his sensibility, he does not reflect, he does not forestall. Between utility and what is pleasing, between the possible pain of to-morrow and the pleasure of to-day he is not long in hesitating.

The true cause of the formation of more or less sedentary and of permanent societies is that altruism which we have seen to be simply the love of self through others and which subsequently becomes a native sentiment as imperious under certain circumstances as egoism. It is the desire, the pleasure, the need of not being alone, of having companions, of exchanging with them one's impressions, of loving and being loved. There are two kinds of animals, those who in daily satisfying their alimentary needs are obliged to be constantly on the alert, defiant, and ready for combat ; and those who having no ordinary ground for conflict give themselves up to the enjoyment of living and are naturally inclined to an existence of peacefulness and pleasure. The first are refractory to the social instinct, their egoism interferes. If they join in assemblages it is from necessity, accidentally and temporarily to hunt their prey. What they form is assemblages and not societies. The second kind, when once on the way, rapidly acquire social habits and progressively gain in altruism what they lost in egoism, coming finally into the possession of a social instinct which in many species is quite powerful. Our meaning is not that individual interest is not manifested in their societies, but that it is secondary there. They live together, they are exposed to the same difficulties of existence, and it is necessary that their action should be mutual and concerted. In the social weaver-bird as it is called (*Philetærus socius*), they have combined for the building of nests and for the rearing of the young side by side with one another ; they have arrived, without a thought of the ulterior end, at the construction of

a common umbrella-shaped roof for their nests. The beavers most likely gathered together in social assemblages before they undertook the construction of their great works. The leaders which the majority of constituted societies appoint, the expeditions which parrots and monkeys organise, are the outcome of a common interest ; but the societies in question were formed beforehand to satisfy the need of living in company.

In a word, sedentary societies, according to the theory which we present, took their rise in and were developed by the altruistic spirit. Individual interest by itself would never lead to anything consistent. Animals, contrary to certain appearances, as well as to the preconceptions of physiology and to ideas quite widely spread, are more sociable than egoistic. We judge them from our point of view. In this light, they are fierce and brutal ; when their immediate material needs speak strongly in them, when their legitimate nervosity intervenes, they are violent, much to be dreaded, and quick in defence. But when these needs are subdued or are easily satisfied they are gentle, kind, and affectionate. The numerous species which man has succeeded in domesticating, from the lizard and the snake up to the elephant, are proofs of this. One must not be guided by particular cases, but must look at the facts in their general bearing. The animal is perhaps superior to man in point of altruism ! Animal societies are less polished, but perhaps more humane, all things being equal, than our own.

4. We shall not dwell on the subsidiary causes which concur in the foundation of societies and which we have already discussed or touched upon incidentally,—the need of play and of outwardly venting one's surplus of vitality, the impulse to sing, to be noisy, or to be heard, the need of exercising authority, of being feared and admired, and conversely the need of being assisted, protected, petted, and loved. (See *The Monist*, 1896, p. 551.) We shall confine ourselves to our general conclusion regarding the influence of phenomena of reproduction on societies.

5. In the first period of reproduction everything is opposed to the social spirit. The male and the female flee from their fellows, retire aside, and recognise only themselves. The instinct which

presides at this period is egoistic to excess: the male must possess his female. Before reproduction he beats her when she does not yield with alacrity to his desires; afterwards he continues to beat her to assure himself of her being absolutely his. The solitaries are everywhere the most unsociable and the farthest removed from the family spirit even in those species where the adult males remain with their females. Nevertheless, they are the most ardent in the period of rut. In the second period, of brooding or gestation, when the male and the female have separated, both may enter the group of which they form parts; in the mammals the female never misses doing so. But when they remain together, the preceding situation is protracted, although it is less animal in form; they form a couple by themselves, have common joys, and experience no desire for comrades. In the third period two cases again are presented. When the family deprived of the male is maternal, at times the mother takes refuge in the general social group, seeking its protection, and at times she remains apart with her young who fill her whole existence. When the family, on the other hand, is paternal-maternal, the mother, satisfied with having a protector for herself and her young, has no other desire, while the father also is happy in the task which he fulfills. The happiness and egoism of two, which we observe in the preceding periods, have become the happiness and egoism of three. They are indifferent to everything which is not themselves. Nothing could be more contrary to the social spirit. Towards the end, however, the male gets surfeited with his task, wanders away more and more, and finally rejoins his companions, when his social instinct carries the day over his family instinct. At other times, when the young are definitively emancipated, he keeps on with the habits which he has acquired with his consort: family love disappears, conjugal love is left. They remain together, and the year following, throughout their whole life, they begin over again their romance of love and of family life. It is still the egoism of two individuals. The gain of this egoism is the loss of the social spirit.

So much for the monogamous family. Is it the same with the polygamous family? Let us explain first what is meant by the

word polygamy. It is applied vaguely to the three periods of reproduction and differs from promiscuity, which is sometimes improperly used. Promiscuity is free copulation, each one of the two sexes indulging in the function with equal rights and according to its caprice. It is divided into polygamy for the male and polyandry for the female. Polyandry is rare among animals ; the infidelities committed by the female are less rare, but they are not uncommon. Generally the female gives herself absolutely for a whole season, and as a rule gives herself to one only. The male in polygamy does not give himself, he takes the females, and considers himself, so long as he is not sated, as their master. If he remains polygamous in the second period, it is because he maintains his rights of proprietorship, and if he remains polygamous in the third, it is because he still maintains them by including the infants which are the issues of his females. But polygamy in the first period by no means determines his conduct in the second and third. A male may have an entire harem in the first and yet subsequently attach himself to but one female, discharging the duties of a father only with the infants of the latter, in a word, may be monogamous. Example, the little bustard or Tetraz. The opposite case is presented by the great bustard or Otis. The male has but one female, but as soon as this one has laid and has begun to brood, he goes in search of another and thus founds several families. In short, the polygamy whose influence we are here examining is not that of the first period, which is mere licentiousness, functional incontinence, as in the turkey and the goat, but that of the third period as in the seal or the elephant.

The conjugal and family ties are looser and consequently, as we have seen, less egotistical and less anti-social, according as they are more removed from monogamy. The more females and infants a family comprises, the more the total store of affection, attention, and protection of which the male is capable is weakened and dispersed. The more this family resembles a harem or a herd of which the male is sultan or chief, the more is it comparable to a little society under the conduct of a single leader. It is very difficult in the accounts of travellers to distinguish the simple numerous family

from the troop or herd of small dimensions. In the Ungulata, the polygamous family often comprises the young of two or three years, although a little later when they have become capable of reproduction their parents usually drive them away. But in other cases, as in the elephant, the young remain in the troop, procreate there, or more probably abandon the troop temporarily to return to it again with their young, with the result that in the end the herd is consanguineous and formerly often embraced as many as a hundred or two hundred members. It is certain that some societies of monkeys are simply augmented families of this kind.

Are polygamous families more capable than monogamous families of forming what Espinas calls *peuplades*, and which we regard as societies *par excellence*? This is the important point to know. Reason answers in the affirmative. Polygamy disperses the sentiment of sympathy, monogamy concentrates it. Polygamy is the egoism frequently of from fifteen to twenty individuals; monogamy is the egoism of three. We have seen numerous instances of polygamous families associating, as in the Tarpan and the buffalo; we have also seen monogamous families, as in the reindeer. But it is my opinion that the former are the most frequent.

We shall take it for granted, then, that polygamy tends more strongly to the formation of animal societies, than monogamy, although it is a lower form of family than the latter. A last reason tells us so. The family of three is a narrowed individuality, intermediary between the individual proper and social collectivity. The family of ten or twenty is a large and diffuse individuality, also intermediary but approaching to collectivity.

It remains to be seen whether, viewing the instrumentality of the young alone, the family favors the formation of society. We have seen, and only the fear of being too prolix has prevented us from dwelling upon it, that the young are invariably controlled by a single dominating tendency—the desire of getting out of their nests as soon as possible, of giving free vent to their activity, and of emancipating themselves, while braving unknown dangers and forgetting their parents. But we have also seen that they are possessed of a powerful impulse to play and to tease one another, to

cry out and to compete in song, even meeting from time to time in some common place for this purpose. To have comrades is a necessity with them. There exist, thus, two contradictory tendencies. The result in the young varies with the species, but in general the more the family state is prolonged the stronger does the habit of living together grow; the more they are conscious of their weakness, the more easily is their food obtained, as in the Herbivora, and the more they yield to the desire of being together; whilst under opposite conditions they abandon themselves readily to their instinct of liberty and of egoism. Nevertheless, small groups of young are formed for hunting in concert among the Carnivora; but occasionally more extensive groups, afterwards rallying to a general flock, are found among the Ungulata.

However a third factor is bound to intervene some day in the case of the young, which puts an end to their inclinations either for independence or for life in common—the arrival of puberty. Birds or mammals, all surrender themselves to the sexual instinct; the soldest ties are broken and the accomplishment of the first act of reproduction takes precedence over everything.

It is certain, however, that the spirit of sociability is most developed in the young who have not yet attained puberty, that it is maintained fairly well after the first rut and even after the first family state, and that it then wanes and quickly drops to zero in the aged males. "Solitaries" are met with in the most sociable species. They are the old males who have spontaneously abandoned life in common or have been expelled from the troop because they were grouty and ill-natured. Age is a factor which must be taken into account, both as regards family and as regards society, when a given species is to be judged. So for the rest there is sometimes wide variations of character, manners, and conduct within the same species. Two travellers may have expressed different opinions and yet both have made correct observations. In many cases it is the mean that has to be sought.

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To adhere faithfully to the plan which we sketched at the outset, whether it be right or wrong, it remains for us to compare

rapidly, not all the forms of association which the vertebrates have presented, but the highest among them, those which best merit the name of societies, with the associations¹ or colonies of lower and intermediary invertebrates.

1. Colonies form a whole, morphologically continuous in all their parts and at all the epochs of their evolution. Societies form diffuse wholes, having a virtual tie only.

2. Colonies tend towards a perfectly definite end, that of multiplying animal forms in time and on the surface of our planet, that of creating new organisms, more and more complex, at the expense of prior simple organisms. This end is wanting entirely in societies. However far solidarity may be carried it is impossible to conceive of a society becoming a new organism or being of any kind. What other end of evolution does it pursue?

As I take it, evolution has no end. It proceeds at random, essays and realises everything that it can, as we have before said, and scoffs at our teleological speculations. Nevertheless, it cannot be denied that among its various operations, regressive, indifferent, and progressive, we are most vividly struck by those which best succeed, by those which engender that admirable harmony revealed by philosophers and lauded by poets. Progressive evolution follows one direction—the *best* by comparison with what has preceded, the best for the species, considering the conditions in which its lot is cast. One of these *best*, as physics and economics have taught us, is the maximum output with a given instrument or organism. We have seen that for the functions of reproduction, progress, amidst attempts of all kinds, has always tended in this direction. Among the fishes we had quantity, but the majority perished; in the higher mammals we had quality, that is, a less number with survival assured. As to the functions of outward life, the same end has been set. Creatures were multiplied in superabundance; what was required was that they should become perfected, that the species should individually yield the maximum output, that is to say,

¹ Evolution has other ways of forming or developing metazoans of increasing degrees of complexity. But the method by organic association is the most widely diffused and the only one which relates to our subject.

that they should exhibit the maximum of activity, of enjoyment, of prosperity, and of well-being. Hence resulted the process of virtual association among demes which evolution follows by habit, and which leads to the strengthening of the ties between the individuals of a species, to their living better, and to the bestowal upon them of more power. By the family, evolution ended in better progeny; by society, it ended in a greater amplitude of life for the species.

The two first differences, in fine, create an abyss between colonies and societies. Comparison seems impossible. But let us continue.

3. In colonies aggregation at first acts by adhesion between individuals which have come from without or are the issue of a common mother; growth is effected by gemmation; total reproduction by the separation of one part, the rest perishing.

In societies aggregation acts by exterior adhesions or by consanguinity; growth by a sort of hypergenesis; reproduction by the separation of a part or swarm, the remainder continuing to live. The parallel is difficult.

4. In colonies division and specialisation of labor are promptly established and more and more accentuated. The individuals form groups which become organs, each concurring within the limits of its specialty in the fulfilment of the general wants. In societies it is the same, each individual is specialised, groups are formed, that is to say, categories; some are favored, others are sacrificed; a hierarchy is established. This is the feature of formal resemblance and one which should be emphasised.

5. In colonies the individuals preserve their independence only for a short time. They almost immediately make concessions to their neighbors, then to groups, and finally to the colony entire; so much so that their individuality becomes entirely absorbed, and they retain no other functions than that of cog-wheels in a great machine. In societies a certain sacrifice of individual independence is also required. The social state is an exchange of concessions; we give in order to receive. But there is a limit; one always preserves the greatest part of one's individuality; one is not bound to

suffer oneself to be absorbed, whatever be the degree of solidarity. This difference is profound.

6. Colonies are presented in the invertebrates in all periods from simple assemblages of individuals with scarcely any adhesion up to complete and absolute solidarisation. We may reduce them hypothetically to three periods. In the first, the individuals still remain their own masters, they lead their own life, and the colonial whole is but their numerical sum. In the second, they have lost half of their individuality, and the colonial whole possesses the other half. In the third, the individuals no longer count as such; they are subordinated to the colonial whole, which wields all the power and all the initiative. In which of these three periods would animal societies fall, on the supposition that we are obliged to class them with colonies, and that we admit they will develop like them in the course of time and in the ascending mammalian scale? In the first, with traces of a tendency here and there towards the second.

In fine, the classing of colonies with societies, which the positivists hold as proper, is a pure fiction, although in some points resemblances exist. If certain laws are applicable to like phenomena in the two orders of association, it is because the grand laws of nature are universal in character and relate as well to sociological or biological facts as to physical, chemical, or astronomical. The plain truth is this: the variously graded associations called colonies are morphological; the associations between demes are virtual. The first create new species, the second perfect them, extend and develop all that they can produce. Will this evolution culminate in the greatest intrinsic good of this or of that species, or in its complete annihilation by very excess of vitality? That is the secret of time. It remains to be learned whether man is situated in this regard the same as the other animals, whether his peculiar attributes do not transform the situation, and whether consequently he will not suggest some modifications of the outlooks gained in the present study.

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